LIBRARY
FISH & WILDLIFE SERVICE
PACIFIC OCEANIC FISHERY
INVESTIGATIONS

THE PROGRESSIVE FISH CULTURIST

NEWS AND VIEWS FROM MANY SOURCES ON PRACTICAL HATCHERY PROBLEMS

ISSUED BY THE

BUREAU OF FISHERIES, U. S. DEPARTMENT OF COMMERCE

Memorandum I-131 | Washington, D. C. July, 1935 | No. 8

PRODUCTION OF BASS FRY

by

Eugene W. Surber, In Charge
U. S. Fisheries Experimental Station
Leetown, W. Va.

IN SPITE OF approximately sixty years of bass culture in this country, there are many details regarding the production of bass fry which have never been studied from a quantitative standpoint. A study of such problems is by no means an easy matter without sacrificing production area, and at most bass hatcheries the superintendent is forced to devote as much pond space as possible to the filling of stacks of applications for fish. Some of the points in production of bass fry which are sorely in need of quantitative study will be cited. Although the spawning habits and methods of collecting and handling fry of the smallmouth and largemouth black bass differ considerably in detail, it is believed that a discussion of the production of fry in both species can be treated simultaneously.

There are two systems or arrangements under which bass fry are produced. One of these, and probably the one now most commonly used, is to confine a comparatively large number of adult bass to a brood stock pond, where the fish are provided with nests and allowed to spawn. Subsequently the bass fry are removed by means of traps, seines, or nets are transferred to nursery ponds where they are reared to fingerling size. Another system is to stock the nursery ponds with a limited number of brood fish and allow them to spawn in the same way, but no effort is made to remove the fry and the adult fish are allowed to remain in these ponds throughout the summer. At the U. S. Fisheries Station, Fairport, Iowa, 25 adult bass—10 males and 15 females—are used in this system to stock each acre of pond. While probably wasteful of fry in some cases, the results at Fairport show that nearly as good results can be obtained by this system as from the first. The ponds in both instances should be fertilized.

The question arises as to the water supply, kind of nests, etc., which should be used in brood stock ponds, as well as the size and depth of the ponds. One of our earlier most successful bass culturists, Lydell (1926, page 43), obtained his best results in the production of fry in egg-shaped ponds about 150 by 180 feet and 5 feet deep. In these ponds the gravel nests were placed at a depth of 2 feet for smallmouth. The proper number of adult bass to place in a brood stock pond has been suggested by Lydell to be 150 bass to the acre.

4425

A new method, originated in Ohio by T. H. Langlois (Langlois, 1931, p. 112), and recently adopted by some bass culturists, is a departure from the older method of producing fry in the manner described by Lydell. In this system the small ponds about 40 feet wide by 80 feet long (as an example) are provided with spawning stalls arranged along the rather steep banks. These stalls are about 4 feet wide and extend about 5 feet out into the pond. A gravel spawning nest is placed inside each stall at about a depth of 2 feet. When the bass are finished spawning and the fry are about to rise from the nests, screens are inserted in slots at the mouth of each stall to prevent the escape of fry into the open water.

Brood stock ponds, especially those in the system first described, should be kept as free of vegetation as possible until after the spawning season, as an excessive amount of vegetation will make the capture of either kind of fry with traps very difficult. Only enough water should be permitted to enter the brood stock ponds to keep the water level constant. Water should not be allowed to leave the pond at the overflow. Particular attention should be paid to leaks since fry are instinctively attracted by down-flowing currents.

Smallmouth bass will spawn on gravel if they can find it in a suitable location, but largemouth bass, on the other hand, are not so dependent on gravel and will spawn on grass roots or any hard surface. Smallmouth bass will also spawn on any hard surfaces, even hard clay if gravel nests are not in locations to suit them. Since bass are not apt to use plain gravel nests when others with shelter are provided, Lydell used a nest box with two sides about 2 feet high with a 6-inch board at the bottom to hold the gravel in. A board with a stone on top was placed on top of the two-sided frame, and three or four inches of gravel was placed in the bottom of the nest. It has been stated that the nests should not be placed closer than 15 feet in order to minimize fighting among males which are the nest builders and guardians of the eggs.

Brood Stock

The statement is heard rather frequently that pound-and-a-half bass make the best brood fish. One cannot find quantitative data, however, to support this statement. Within certain limits such as old age, it seems logical to believe that the larger the bass, the more eggs they will produce. It is important that bass of uniform size be placed together. It has been quite a general experience that wild fish will not yield fry during their first season; that is, if captured shortly before the spawning season. However, at least two places are known to the writer which are dependent on wild fish each year for their breeders.

Since the eggs for the succeeding season begin forming in the ovaries of the female bass immediately after the spawning season, the fish, therefore, should be fed well throughout the summer and enter the winter period in the pink of condition. Several observers have noted that adult bass will not produce a large number of eggs or fry if fed on artificial food. Buller once stated (Transactions of the American Fisheries Society-1923 "Foods and Feeding of Fishes; A Symposium," page 144): "We have never in all our experience been able to retain smallmouth black bass in any of our ponds that would reproduce on artificial food."....."We have come to the conclusion that what work we do in the future with the smallmouth black bass will be done with live minnows."

During the 1935 season at Leetown, we have obtained a good hatch of smallmouth bass fry from adult bass whose main food has been beef liver and salmon egg meal in a 70:30 mixture. These adult fish were taught to take the salmon egg mixture through a gradual feeding routine which started with hand feeding crippled minnows, then beef hearts cut in strips, and finally the beef liver salmon egg mixture. Late in the fall when the water temperature drops below 55°F., feeding on the artificial food begins dropping off. Minnows are introduced into the holding ponds to tide the fish over the winter in good condition. It is believed desirable to avoid feeding minnows through the summer if artificial feeding, which will result in good fry production, can be used. The collection of minnows, in the first place, is time-consuming and, therefore, expensive. Oftentimes, such as late in the fall, minnows are difficult to catch in large quantities. Another important factor to take into consideration is that minnows are carriers of parasites which may affect adult bass. When handling adult bass, transferring them from pond to pond, it is a good practice to dip them each time in a 3-percent salt solution for from 1 to 3 minutes.

While most stations do not sex the adult bass before placing them in the brood stock ponds, it is believed desirable to do so. One male bass is sufficient for each two or three females. The sexing of smallmouth bass is not such an easy undertaking. It must be done shortly before the spawning season. Reighard (1906, page 11) probably was one of the first to call attention to the characters distinguishing the female from the male. He has noted that the female when approaching the spawning season possesses a white spot at the free border of the opercle. This white spot stands out with great distinctness during sexual excitement. While over the nest, the female changes color somewhat and mottlings appear. These mottlings may be brought out by transferring the fish from warm to cold water, 65° to 50°F. The upper and back part of the male eye (iris) is scarlet, while that of the female usually remains brown. If the brood fish are sexed within a short time of the spawning, the females may also be distinguished by their obesity while the males are slender. Largemouth bass are rather easy to sex because the male possesses a rather sharp keel immediately anterior to the vent.

The Spawning

Males of both species are the nest builders and guardians of the eggs and fry, although parental care is considerably more developed in the largemouth than in the smallmouth bass. The largemouth attends his nest more closely and remains with his school of fry sometimes for long periods after they leave the nest. Largemouth fry ¾ to 1 inch long have been observed attended by the male. Although the male smallmouth bass may begin preparing his nest at about 60°F., it is generally agreed that spawning takes place as soon as water temperature of the spawning pond reaches 62° to 64°F. The spawning does not occur simultaneously among all fish and a single female may spawn more than once. The most desirable thing is to have a uniform spawning; that is, all fish spawning at about the same time. At Leetown during the current year, practically all of our smallmouth bass appear to have spawned within about a week. Certain bass culturists (East, 1930, page 153 and others unpublished) have retained their brood stock in spring-fed ponds, keeping the water temperature lower than the brood stock ponds. When the wintering pond reaches a temperature that seems to stimulate the spawning season, or the temperature of the brood pond reaches about 65° to 68°F., they are transferred to the brood pond where they spawn quickly. It is very desirable, of course, to obtain fry of uniform size, since each nursery pond should be stocked with fry of uniform size to avoid cannibalism at a later period.

The smallmouth bass have very interesting nest building habits. Circular gravel nests, two to four feet in diameter, are hollowed out in the gravel. They frequently go to the trouble of sorting stones in such a manner as to leave the larger stones in the center of the nest. Smallmouth bass nests are usually in water from 18 inches to 6 feet in depth and nests have been reported at even greater depths.

There are several interesting accounts of the actual spawning process but it is necessary to omit a detailed account in this paper.

The very small eggs of both species are adhesive, sticking to the sides of the stones, grass, roots, or other materials upon which they are deposited. The incubation period of the eggs varies from about five days to two weeks or more depending upon the water temperature. The colder the water, the slower is the development of the eggs. Lydell (1904, page 40) gives the time for hatching of eggs as five days at 66°F. Ordinarily the males are present over or about the nest and occasionally fan the nest with their fins. In clear water ponds, however, smallmouth bass frequently pay little or no attention to their nests during the incubation of the eggs. In one of the clear water spawning ponds at Leetown during the current season, several nests of fry were found which had apparently no attention and few of the nests appeared to be guarded closely by adult fish. The number of eggs which are deposited in a single nest runs from about 2,000 to about 10,000.

Conditions Affecting the Hatching and Survival of the Eggs

Weather conditions have much to do with the success of a spawning. An early warm spell sometimes causes the adult fish to spawn before danger of losses from cold weather are over. The writer recalls an instance in a Mississippi River slough in Minnesota, which was used as a largemouth bass brood stock pond, in which most of the adult bass spawned on or about April 24, 1931. After this spawning the weather became cold, and the water temperature dropped below 50°F. A few days later one could walk along the shore of the slough and observe the dead eggs in the nests which had been deserted by the male fish. It is believed that the nests will be deserted if the water temperature falls much below 50 degrees.

Ordinarily, bass eggs, particularly largemouth bass, probably suffer little from destruction by other animals which might eat them, since the male fish is usually in attendance to drive off enemies. With smallmouth, the case in clear water may be very different. Young sunfish and young bass are particularly fond of eggs and the writer has observed both species dive into the nest of other fish after eggs. Fingerling smallmouth bass have been seen eating sunfish eggs during the absence of the male (frightened from the nest) and two to four inch sunfish have been observed eating the eggs of their own kind or the eggs of sunfish several times their size.

Langlois (1933, page 392) suggests that Hydra might cause destruction to the eggs. Although none of these little animals were observed engulfing the egg , some were found attached to them and he observes that adult fish apparently deserted the nest wherever Hydras were abundant.

After hatching, the young bass of both species remain on the nests until their yolk sacs are absorbed, the length of time depending on the water temperature. They will sometimes rise for a short distance above the nests during the day and settle back at night. Smallmouth bass fry are black in color at this stage while the largemouth are nearly transparent.

The Capture of the Fry

It is best to capture the smallmouth bass fry before they abandon their nests while largemouth fry may be allowed to leave their nests since they can be captured more easily at a later time.

The smallmouth bass fry hover for a few days in the vicinity of the nests then disperse and scatter widely among the vegetation (if there is any) along the margin of the brood stock pond. Although a seine or bobinette net is sometimes used to capture them along the shores, this method is time-consuming and often produces little worthwhile results. If the shore is free of vegetation, Hesen traps may be set at right angles to the shore line and save much of the time wasted in seining them. However, as stated above, it is better to capture the fry before they leave the nests. If a pond without stalls is used, circular frames about 28 to 34 inches in diameter and about 40 inches deep will be found convenient for placing over the nests. These frames are built of 1-inch band iron and covered with fine copper screen sixteen meshes to the inch. A funnel of cheesecloth is made about a 3-inch ring of heavy wire and placed over the bottom. One piece of cord is used to tie the cheesecloth tightly around the bottom of the frame and one or two pieces of cord must be attached to the ring and tied to the top ring of the frame in such a manner that the ring and aperture in the cloth funnel will be about 6 to 8 inches above the bottom of the trap. One has then a screen cylinder with an inverted cloth funnel at the bottom. At the apex of the funnel is a 3-inch aperture (ring) through which the fry rise into the cylinder and are unable to find their way out. One or two Hesen traps may be used in conjunction with these cylinders for capture of the fry which work along the shore line.

The largemouth fry remain in a compact school after leaving the nest. The school of fry is attended and kept together by the male bass until they are about three-quarters of an inch long. In a pond where there are a number of these schools of fry, they merge together to form large schools which work rapidly about the shore line in their search of food. The Hesen trap described by Hesen (1929, pp. 118-125) consists of a pound, 4 feet square and 2 feet deep, with a 16 foot lead entering the center of one side of it through two hearts. The lead is set at right angles to the shore line in such a manner that the fry will be deflected into it in their passage about the pond. If wooden stalls are used, it is necessary only to slip the screen in place. A water-tight cylinder with a glass bottom will be found convenient for close observation of the nests.

When smallmouth fry are captured just before they leave the nest, they are usually very small. Handling them or counting them individually is time-consuming and weighing them in bulk for distribution to the nursery ponds is dangerous, and if the weather is warm, many are killed. If held in stalls, they cannot be fed adequately with cultures of Daphnia magna because this species of water flea is too large for the very small fry to swallow. It will be necessary to study cultural methods of raising smaller species of water fleas or protozoa which can be consumed readily by the very small fish.

Quantitative distribution of the fry to the bass nursery ponds is very desirable. It may be accomplished as follows: Count out 1,000 fry, pour them into a net of bobinette, allow them to drain for 45 seconds, relieve weight with hand by placing it beneath the net and transfer quickly to a pan of water which has been balanced previously, determine their weight, and use this figure for calculating the total weight of fish with which it is desired to stock a certain pond.

4425

It is a controversial matter at present how many fry to introduce per acre of pond. The proper number has been estimated to be from 15,000 to 50,000 fry to the acre. The Bureau of Fisheries at its Fairport, Iowa, Station obtained consistently good results stocking at the rate of 25,000 fry to the acre (Davis and Wiebe 1930). Nursery ponds should be put in readiness to receive the fry well in advance of their introduction. Fertilizing these ponds to obtain maximum survival should start probably a month or six weeks in advance of the time the fry are introduced.

Just what conditions are ideal for the survival of the largest number of fry are unknown. New ponds flooding grassy or weedy meadows have been very successful. It is suspected that the slope of the borders of the pond has much to do with the percentage of survival of the fry. It seems logical to believe that there would be fewer fish surviving in a pond with a "feather-edge" where the young bass are at the mercy of blackbirds, herons, and other water birds. A depth of not less than 6 inches in the shallower parts of a nursery pond would seem desirable. Experience in this country is beginning to show that a fairly good growth of vegetation favors high survival. A number of insects prey upon the small bass. The nymphs of large dragonflies are important enemies of the young fry. Langlois (Kingsbury, 1934 p. 138) observes that the large nymphs of Anax junuis are most destructive, and that since they require two years to complete their nymph stage in the water, they can be destroyed by draining the ponds and drying them thoroughly at the conclusion of each season. Backswimmers, large species of water boatmen, giant water bugs, common water bugs (Zaitha flumineum), Dytiscid beetle larvae and probably other air-breathing aquatic insects prey on the small fry. They become particularly abundant in the small, long, narrow ponds in which the fry are now being stocked heavily for artificial feeding. Most of these carnivorous insects obtain their supply of oxygen by thrusting respiratory tubes or setae through the surface film of the water. This habit has been utilized for their destruction by spreading toxic oils over the surfaces of ponds where these animals have become numerous. Langlois (1932, p. 165) used kerosene oil at the rate of 10 gallons to the acre while Kingsbury (1934) has used cod-liver and salmon oils. Ellis has suggested the use of pure crude petroleum washed once with water to remove the toxic materials normally present.

Investigators who have studied the food of small bass have found that they feed upon entomostraca almost entirely until they reach a lengh of about 35 millimeters (Wickliff, 1920, and Turner and Kraatz, 1920). It is suggested that young bass should no longer be termed fry after they reach a length of 35 or 40 mm., which marks the natural transition period in feeding from entomostraca to insect larvae, nymphs, and adults.

Literature cited

Davis, H. S. and A. H. Wiebe
1930. Experiments in the culture of the black bass and other pondfish. Bureau of Fisheries Doc. No. 1085.

East, Ben
1930. Bronze-sides the gallant, how Michigan keeps him in her streams. Nature Magazine, Vol. 16, No. 3, pp. 152-154.

Hesen, Herman O.
1929. A trap for the capture of largemouth bass fry and fingerlings. Transactions of the American Fisheries Society, Vol. 59, pp. 118-125.

Kingsbury, Oliver R.
1934. The new bass hatchery at South Otselic, New York, and its first year's operations. Transactions of the American Fisheries Society, Vol. 64, pp. 132-142.

Langlois, T. H.
1931. The problem of efficient management of hatcheries used for the production of pond fishes. Transations of the American Fisheries Society, Vol. 61, pp. 106-115.

1932. Problems of pondfish culture. Transactions of the American Fisheries Society, Vol. 62, pp. 156-166.
1933. More problems of pondfish culture. Transactions of the American Fisheries Society, Vol. 63, pp. 391-403.

Lydell, Dwight
1904. The habits and culture of the black bass. U. S. Fisheries Comm. Bull., Vol. 22, 1902 (1904), pp. 39-44.
1926. Smallmouthed bass propagation. Transactions of the American Fisheries Society, Vol. 56, pp. 43-46.

Reighard
1906. The breeding habits, development and propagation of the black bass (M. dolomieu) and Micropterus salmoides. Bull. Michigan Fisheries Commission, No. 7, pp. 1-73.

Turner, C. L. and W. C. Kraatz
1920. Food of young largemouth black bass in some Ohio waters. Proceedings of the American Fisheries Society, Vol. 50, pp. 372-380.

Wickliff, Edward L.
1920. Food of young smallmouth black bass in Lake Erie. Proceedings of the American Fisheries Society, Vol. 50, pp. 364-371.

- 0 -

OUR ERROR

WE MIGHT BLAME IT on the type setter, the proof reader, or the office boy, but the fact remains that an error crept into our last issue. Refer to page 7 of the Progressive Fish Culturist, No. 7 for June. For the average length of bass produced in Ohio read 5.37 inches instead of .37 inches. Our apologies to Mr. Langlois.

4425

IMPORTANT ANNOUNCEMENT

HATCHERY DISEASE SERVICE ESTABLISHED

THE DIVISION OF SCIENTIFIC INQUIRY, U. S. Bureau of Fisheries, in carrying out the original purposes of Congress to discover if any and how great a diminution of food and game fishes of the United States has occurred, what the causes of the same may be, and what remedial measures may be proposed, has established a consulting HATCHERY DISEASE SERVICE to aid in averting the havoc of epidemic diseases among hatchery fish.

This DISEASE SERVICE, or fish clinic, will examine specimens of diseased hatchery fish forwarded by mail to its laboratories properly preserved in special containers, prepare diagnoses if possible, and send recommendations for treatment and control if known by return mail, or if requested by wire collect.

Two pathological laboratories are maintained by the Bureau, one at Washington, D. C., under the direction of Dr. H. S. Davis, and one at Seattle, Washington, under Dr. Frederic F. Fish. Mailing tubes containing bottles and preservative with instructions for use and a form for recording pertinent information may be obtained on request. Until public demand requires an increase in facilities and personnel the service will be limited generally to producing hatcheries, Federal, State, and private commercial. For the present it is impossible to extend the service to household aquarium fishes.

The accompanying article by Dr. Fish, to whom much credit is due for proposing the development of such a service, explains in more detail the operation, character of service, and benefits to be derived from the clinic.

The mailing addresses are: Pathologist, U. S. Bureau of Fisheries, Washington, D. C., and Pathologist, U. S. Bureau of Fisheries, 2725 Montlake Boulevard, Seattle, Washington.

Please note that the DISEASE SERVICE is available without cost to Federal, State, and private hatchery men.

Elmer Higgins
Chief, Division of Scientiiic Inquiry

4425

The Progressive Fish Culturist No. 8—9.

THE BUREAU OF FISHERIES' DISEASE SERVICE

by

Frederic F. Fish, Ph.D.
Associate Aquatic Biologist
U. S. Bureau of Fisheries

PICTURE YOURSELF BENDING over a trough picking eggs. The clatter of hoofs suddenly rings from the snow-covered hatchery roof—or if you must be technical--from the driveway. The hatchery door opens and in walks a bewhiskered gentleman wearing a brilliant red suit—it's Santa Claus. He walks slowly over to where you are standing—he speaks—

"Brother, could you spare a dime? In return for one thin dime, I will reward you with adequate information, if I possess it, upon any subject which will help you as a fish culturist."

The chances are just about a hundred to one that you will reply, "Well, Claus, how about fish diseases, and the dime is yours."

Your dime is perfectly safe. Your visitor slowly retraces his steps to the door, climbs into his sleigh, shifts gears, and is off. Suppose he lands at another hatchery in the next state and makes that same offer. Would you bet next month's pay check that your fellow fish culturist would not request exactly the same information that you did? I thought not—fish diseases are too important an item in the life of a hatcheryman to pass up any opportunity for information about them.

However, that isn't getting Santa his dime for a cup of coffee and a piece of pie. After a few more stops, the old boy will probably see that if on his return trip he is armed with some information on fish diseases for retail distribution, his reward will be no slab and Java but a ten-course roast turkey dinner. The most logical source for information on this subject would be, of course, a fish pathologist of which there are a few. Accordingly, Santa hies himself to the laboratory, slides down the fume hood and accosts the gaunt, long-nosed, sad-eyed pathologist who is sitting before his microscope, thinking—or perhaps he is just sitting.

"Path, old boy," says Santa, "I would like to know a lot about fish diseases."

Whereupon the pathologist, as he slowly uncrosses his squeaking knees, replies, "Santy, Old Top, so would I."

Which, I might add, brings me to the point of this story. Just who can tell us all we want to know about fish diseases? The answer is easy. A six-letter word, beginning with N and ending with Y, meaning no one at all. Cheerful isn't it?

Furunculosis was discovered as a disease of trout in 1893 and we have absolutely no cure for it in 1935. Records of blue-sac have been found as far back as 1904, and the control of blue-sac is just as effective as that for furunculosis. Octomitis was first described in 1923 and we may, or may not, have a control. The same might be said for Chilodon which was first seen in 1833; Costia, described in 1883; and Ichthyophthirius, described in 1873. Bacterial gill disease, the baby of them all, was first seen and described a scant 10 years ago. This youngster can be eradicated.

Whereupon you will probably rise up in a rage. Here I sit and tell you about a group of diseases which have been known from 10 to over 100 years and only 2 or 3 of them can be controlled even half way. What the heck have the pathologists been doing to earn their pay anyway? Hang onto the shirt for one moment and get this: At the present time, a mill worker could count the number of scientists engaged in solving the problems of fish diseases on the fingers of the hand that argued with the buzz saw. In fact, the total number of investigators who have ever worked primarily on fish diseases could be counted on the fingers of two normal hands. As the shirt comes off, you probably remark that even 10 good scientists should have gotten farther than they apparently have.

Consider, if you will, the progress made in a similar field--human medicine—which was an established science long before diseases of fish were even thought about.

There is a worm parasite of humans, Dracunculus medinensis by name, which has been known for a good many years. In fact, it was mentioned by Moses (Numbers XXI) as causing no end of trouble among the Israelites by the Red Sea. Today, should you find yourself infected, there is little that modern medicine can do other than allow the parasite to run its course and trust that it passes out before you do.

An extreme example you say. Well, consider the common cold. This disease attacks practically every human being in the world at least once a year and has been doing so from time immemorial. Probably no single disease has ever been subject to more research; fortunes have been spent employing world renowned scientists furnished with the best medical equipment that man can devise or that money can buy, and what do we know about the common cold? Darn little. We don't even know what causes it or what can be done to check it.

If you wish to read an interesting chapter in the history of human medicine, the story of bubonic plague will start your flesh crawling. Plague has been one of the worst scourges of the human race. From time to time it has swept over the entire world in relentless waves, exacting a toll of life unequalled by that of any other epidemic disease. In the fifth and sixth chapters of the first book of Samuel, one finds an unmistakable account of bubonic plague. Before the birth of Christ, there are definite records of 109 epidemics. Between 1500 and 1720 A.D. there are 45 world wide epidemics of plague.

If you think that the time of hundreds of scientific workers and millions of dollars spent in the eradication of plague have cleaned out the disease, the facts are a bit discouraging. As recently as 1900, epidemics appeared in such modern cities as San Francisco and Glasgow. Today, plague pops up all over the world and from 60 to 90 percent of all cases of plague end with the undertaker, in spite of the best care that medical science can offer. In India, the chief center of the disease, over 10,250,000 deaths from bubonic plague alone were recorded between 1898 and 1918. An even more distressing fact about plague is that it is continuing to spread among the rodents of the world, which act as reservoirs of the disease, in spite of all efforts to stop it. Plague still hangs over the world like a thunder cloud, ready to strike at any time, and what chance has the person whom it hits?

So much for human medicine. These examples are not selected, but chosen at random and they are only used to show that the conquest of human diseases by hundreds of the best trained pathologists with millions of dollars, is a pretty slow proposition.

4425

After reviewing the situation in parts of human medicine, one cannot help but feel that after all those 10 pioneers in the field of fish diseases have done pretty well considering their very limited means and opportunities. For instance, Dr. H. S. Davis hit the bull's eye with a description of bacterial gill disease; and in the same paper, he outlined a control, which if properly applied, is practically 100 percent effective. There are not many parallel cases in human medicine wherein a disease and its effective control have been described in the same paper.

When one considers the vast amount of skilled research and the tremendous sums of money that have been spent to find specific cures for those few diseases of humans which can be cured, it rather looks as though we might confidently anticipate the announcement of a specific cure for furunculosis about 2019 A.D. and perhaps one for Octomitiasis will come a bit sooner, say 1985. Also, one will realize that this span of required time is not because fish pathologists are lazy creatures, but rather because advancing the knowledge of disease is an unbelievably complex task. Like the proverbial construction of Rome, it cannot be done in a day.

However, you say that we cannot wait until 2019 A.D. to find a cure for furunculosis and that the thought that you must wait until 1985 to adequately combat Octomitis infections is not comforting. These diseases will claim entirely too many fish between now and then. Why doesn't someone do something about it right now, regardless of how tremendously complex and time-consuming the job may be?

The Division of Scientific Inquiry is doing something about it and needs the help of every hatcheryman. Strange to say, the pathologist cannot do all of his work in the laboratory, yet funds are not sufficient to allow him the necessary field work. Accordingly, the Division of Scientific Inquiry has inaugurated a DISEASE SERVICE to bridge the gap in the most satisfactory manner now available. This DISEASE SERVICE has been established with two objectives in view. The first objective is to help you, as a hatcheryman, to solve the problems offered by diseases at your particular hatchery in accordance with the best of modern knowledge. The Division asks you to take advantage of this offer. It will supply you with mailing tubes containing vials of the proper preservative with the request that you send specimens to the nearest Pathology laboratory (Washington, D. C., or Seattle, Wash.) for diagnosis at any time that you believe a disease is appearing among your fish. The diagnosis will be made and returned to you immediately with the recommended method of treatment, if such is known. This SERVICE goes farther. It will furnish you the answer, insofar as it may be known, to any question which you may have regarding fish diseases and what particular measures you can take to prevent the appearance of diseases at your hatchery.

As a sample of the versatility of this SERVICE a recent letter from a hatchery superintendent stated that he could observe no beneficial results following the salting of his fish although salting was the method of treatment which had been recommended to him by this SERVICE. He had been performing this salting by drawing his circular pools to a level which he estimated left 100 cubic feet of water in the pool, adding the necessary amount of salt, and the results were nil. In writing his difficulties, he wisely included full dimensions and the water level of his ponds. When figured out in black and white, it appeared that the estimated 100 cubic feet of water was actually very close to 400 cubic feet. This was a natural mistake in estimation; in fact, the answer was a bigger surprise to the pathologist than to the fish culturist.

4425

Assistance to the hatcheryman in diagnosing diseases and recommending preventative measures as well as treatments is but one objective of this SERVICE. The other objective is to obtain accurate information on fish diseases for the pathologist. The individual hatcherymen alone can meet this objective. A mimeographed questionnaire accompanies each mailing tube sent to the hatchery by this SERVICE. The pathologist asks, but does not demand, that you answer any—or all— of the questions to the best of your knowledge. If you do not care to answer the questions, your troubles will still be diagnosed. However, before you decide that you had better cover up diseases at your hatchery, remember that your answers may help in furnishing the only key to specific problems on fish diseases. Your answers will be kept in strict confidence and they are in no way a reflection against your ability as a fish culturist. They merely represent your willingness to cooperate in helping to solve your own problems.

All that is necessary to enjoy the privileges of this SERVICE, whether you are in the employ of a State or Federal hatchery, is to write to the nearest Bureau Pathology laboratory. The mailing tube, vials of preservative, and full directions will be sent to you as soon as possible. When trouble appears, you immediately send in a few specimens and the diagnosis will be returned to you by mail or if requested, by wire collect.

This SERVICE is not new. It has been available for years but few hatcherymen have realized that such assistance could be had for the asking. This SERVICE has saved a good many fish in the past, and it is hoped that many more will be saved in the future. This SERVICE does not claim to be perfect. Some diseases of fish cannot be recognized from preserved specimens, and some of the diseases which can be recognized cannot be controlled. There are, unquestionably, diseases among our hatchery fish concerning which we know nothing. We hope to learn and it seems as though the best way is through close cooperation between the pathologists and the hatcherymen, for after all, their problems are one and the same.

With this close cooperation, it is believed that the control of Octomitis and Furunculosis will be old stuff by the time 1985 and 2019 roll around. And we might add that Santa may get that roast turkey dinner before he is too old or too thin to enjoy it.

REVIEWS

"WHAT IS THE DECIDING FACTOR IN TROUT GROWTH?" by C. Stratton Gerrish. The Salmon Trout Magazine, No. 78, March 1935, pp. 13-21.

MR. GERRISH FINDS that the growth rate of trout depends upon the length of the growing season and the inclination to feed within that period. Water temperature is only material insofar as it affects the amount of dissolved oxygen in the water. Other factors such as a fall in atmospheric pressure and loss of turbulence affect the oxygen content, but temperature seems by far to be the most important. He observes that unless there is a certain percentage of dissolved oxygen in the water trout cannot feed at all. There is also a minimum temperature below which trout cannot feed. This is believed to be about 40°F. If a too sudden rise of temperature or a sharp fall in atmospheric pressure occurs, the trout will stop feeding for a while. After a long period above 60°F., the trout become acclimated and feed to a limited extent. In the Lambourn in England, the trout feed freely between 40 and 56°F. while from 57° upward the ability to feed deceeases rapidly until at 60°F. feeding becomes impossible. The above mentioned temperatures are night minima only and are applicable to trout two years old and upwards. He observes that yearlings are less sensitive to

temperature changes and fry are less sensitive still. In the larger rivers such as the Kennet, trout feed up to 56°F.

The author presents the very interesting hypothesis that the presence of iodine in the water enables trout to grow to larger size because the maximum feeding temperature is increased by the iodine content. He points out that in some waters of New Zealand, where trout grow to tremendous size, an iodine content of as much as 17.5 parts per million has been recorded. The iodine conten' of the larger streams is higher than their headwaters. This suggests an explanation of why larger trout are taken in the larger waters. He believes that the higher iodine content enables trout to utilize a greater portion of dissolved oxygen. In New Zealand trout are reported feeding heavily up to 73°F. and probably higher. He reports an experiment with iodine at the Piscatorial Society's Lake at Newbury. The lake water (from the Lambourn) was treated with potassium iodide at a rate equivalent to about four ounces of iodine per acre of water 4½ feet deep (i.e., 0.5 parts per ten mi lion). Eight doses were applied between June 27 and July 10, 1934, a time of year when the water gets warm and growth normally decreases. After adding the iodine, the growth doubled where it normally decreased. He personally does not regard this experiment conclusive of the virtues of iodine, but does not know how otherwise to explain the phenomena.

Another interesting observation which he made in this lake was the fact that the maximum feeding temperature of rainbows is normally 4°F. higher than for brown trout.

E. W. Surber

"BEEF LIVER FOR FEEDING FISH SHOULD BE KEPT FRESH," by W. A. Riddell.

Progress Reports of the Pacific Biological Stations, No. 23, p. 14-15, 1935.

EVERY FISH CULTURIST confronted with the problem of feeding liver to fish will be interested in the work of Dr. Riddell on the decomposition rate of beef liver. This publication represents a preliminary report of his investigations of the changes occurring in liver during decomposition with the aim of evolving methods for effectively reducing decomposition in stored liver to a minimum.

In this preliminary report, Dr. Riddell described the rate of decomposition in unground liver stored at various temperatures as shown by pH determinations. As every fish culturist knows, as liver spoils it becomes sour, or technically speaking, there is an increase in the acidity present. As decomposition progresses, the acidity becomes progressively greater. The most convenient measure of acidity is the familiar pH determination in which an increasing acidity is expressed by figures decreasing from 7.0, and conversely, increasing alkalinity is expressed by figures increasing from 7.0. In short, the lower the pH reading, the greater the acidity present.

Dr. Riddell took equal parts of freshly killed beef liver, which gave a pH reading of 6.7 (i.e., slightly acid) and maintained these samples at 43°, 61°, 68° and 86°F. and measured the pH of the samples at subsequent intervals.

As an example, the sample of liver maintained at 43°F. showed practically no decomposition (i.e., no increase in acidity) until 60 hours later. After 60 hours of storage at this temperature, decomposition set in with increasing rapidity until 140 hours had elapsed when the rate of decomposition markedly decreased. The same results occurred at higher temperatures, although as the temperatures increased, the time required for decomposition became considerably less.

Briefly tabulated, Dr. Riddell's findings were approximately as shown below.

pH Values of Liver held at different temperatures for varying periods

	43°F. (6°C.)	61°F. (16°C.)	68°F. (20°C.)	86°F. (30°C.)
8 hours	6.7	6.7	6.7	6.7
13 "				6.6
19 "				5.9
21 "				5.4
25 "	6.7		6.5	5.3
27 "			6.4	5.1
30 "			5.6	
33 "			5.4	4.9
36 "		6.4		
45 "			5.2	4.8
50 "		6.0		
54 "			4.8	4.8
60 "	6.6	5.2	4.8	
75 "		4.9		
85 "		4.8		
110 "	6.0			
120 "	5.8			
130 "	5.4			
140 "	5.1			
150 "	5.0			
165 "	4.9			

Dr. Riddell's conclusions were:

1. Liver may be kept for several days at low temperatures without spoiling.
2. Whole, unground liver keeps better than pulped or ground liver.
3. During hot weather, if chilling facilities are not available, liver should not be stored longer than two days before using.

F. F. Fish

4425